

Remarks

Claims 34, 35 and 163-170 are pending in the Application.

Claims 34, 35, 163-166 and 168-170 are rejected.

Claims 35 and 167 are objected to.

Claim 35, 167 and 163 are amended herein.

I. REJECTIONS UNDER 35 U.S.C. § 103(a) OVER LI

Examiner has rejected Claims 34, 35, 163-166 and 168-170 under 35 U.S.C. § 103(a) as obvious over Li et al., "Large-Scale Synthesis of Aligned Carbon Nanotubes," *Science*, Vol. 274, December 6, 1996, pp. 1701-1703 ("*Li*"). Office Action at 2. Applicant respectfully traverses these rejections.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant's disclosure. See M.P.E.P. 706.02(j); see also *In re Vaeck*, 947 F.2d 488, 20 U.S.P.Q.2d 1438 (Fed. Cir. 1991).

Claim 34. Claim 34 claims a method for forming macroscopic molecular array of tubular carbon molecules, said method comprising the steps of:

- a) providing a nanoscale array of microwells on a substrate;
- b) depositing a metal catalyst in each of said microwells; and
- c) directing a stream of hydrocarbon or CO feedstock gas at said substrate under conditions that effect growth of single-wall carbon nanotubes from each microwell.

With regard to Claim 34, *Li* does not teach such a method for forming an array of tubular carbon molecules. First of all, *Li* does not provide a nanoscale array of microwells on a substrate. The substrate of *Li* is mesoporous silica, a three-dimensional surface with a large surface area derived from the mesopores. Such silica is amorphous and has randomly-arranged pores formed from interconnecting, generally round spaces in the silica. As such, the pores have different, sizes, shapes and pathways through the silica. “The growth direction of the nanotubes may be controlled by the pores from which the nanotubes grow.” See *Li*, Abstract, p. 1701. Thus, *Li* teaches nanotubes growing in all directions throughout and from a three-dimensional porous surface. Since the pores are not regularly-spaced or directed, such pores would not be considered an array. Furthermore, such irregularly-shaped pores could not be considered microwells, which are ordered arrays of regularly-shaped wells. Thus, there is no suggestion or motivation, either in *Li* or in the knowledge generally available to one of ordinary skill in the art, to modify *Li* to provide an array of microwells on a substrate.

Furthermore, *Li* does not deposit metal in each of said microwells. *Li* mixes a metal salt with a sol-gel to form mesoporous silica with metal oxide embedded in the pores. Thus, *Li* does not teach or suggest depositing metal catalyst in each of said microwells. Depositing metal catalyst on mesoporous silica could even compromise the pore structure of the mesoporous silica of *Li*. Thus, *Li* does not teach or suggest microwells, and there is no suggestion or motivation is provided in *Li* or in the knowledge generally available to one of ordinary skill in the art to modify *Li* to deposit metal catalyst in an array of microwells on a substrate.

Furthermore, *Li* does not teach or suggest a method for growing single-wall carbon nanotubes from a microwell. The nanotubes of *Li* are multi-wall carbon nanotubes and oriented in all directions through and from a three-dimensional mesoporous silica support. That *Li* makes large-diameter multi-wall carbon nanotubes is supported by Figure 3 of *Li* which states “The tube is well graphitized and consists of about 40 concentric shells of carbon sheets with spacing between the sheets of 0.34 nm. The inner and outer diameters of the tube are 3 and 34, nm, respectively.” Further evidence that *Li* teaches multi-wall nanotubes is found in *Li*, p. 1703, col.

1, par. 1, “The smallest diameter of carbon nanotubes prepared by our method to date is ~ 10 nm.”

Examiner has noted, “*Li* does not emply SWNTs but indicates on page. 1703 (left) that they could be made by optimizing conditions for their growth.” Office Action at 2. However, *Li* states “We believe that it is possible to produce arrays consisting of very thin, and possibly even single-layered carbon nanotubes, by improving growth conditions.” *Li* at Col. 1, p. 1703. However, *Li* does not give any direction or insight how this might be done; rather ***Li* only states that it is a “possibility.”** *Id.* A particular parameter must first be recognized as a result-effective variable, that is, a variable that achieves a recognized result, before the determination of the optimum or workable ranges of said variable might be characterized as obvious. M.P.E.P. § 2144.05; *see also In re Antonie*, 559 F.2d 618 195 U.S.P.Q. 6 (C.C.P.A. 1977).

Moreover, this argument by the Examiner is basically that it would have been obvious “to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result, where the prior art gave either no indication of which parameters were critical or no direction as to which of many possible choices is likely to be successful”; such an argument is an improper *obvious to try* rational that has been flatly rejected by the Federal Circuit and its predecessor courts. M.P.E.P. § 2145(X)(A); *see also In re O’Farrell*, 853 F.2d 894, 903, 7 U.S.P.Q.2d 1673, 1681 (Fed. Cir. 1988) (and cases cited therein). It is well settled that the “admonition that ‘obvious to try’ is not the standard under § 103.” *Id.*

Taken as a whole, *Li* does not suggest or provide all the claimed elements of Claim 34, and, furthermore, there is no suggestion or motivation in *Li* or in the knowledge generally available to one of ordinary skill in the art to form microwells on a surface and grow single-wall carbon nanotubes from each microwell.

Therefore, as a result of the foregoing, Applicant respectfully notes that a *prima facie* case of obviousness has not been established, and respectfully requests that the Examiner withdraw his rejection of Claim 34 under 35 U.S.C. § 103(a) as being anticipated by *Li*.

Claim 163. Claim 163 claims a "method for forming a macroscopic molecular array of single-wall carbon nanotubes comprising:

- (a) providing an array of a plurality of metal catalysts on a substrate; and
- (b) directing a stream of carbon containing feedstock gas at the substrate under conditions for growing single-wall carbon nanotubes from at least one of the plurality of the metal catalysts."

With regard to Claim 163, *Li* does not teach a method for forming an array of single-wall carbon nanotubes. First of all, *Li* does not provide an array of metal catalysts on a substrate. As stated above, the substrate of *Li* is mesoporous silica having embedded iron nanoparticles. See *Li*, Abstract on p. 1701. In *Li*, iron particles are embedded in a three-dimensional amorphous surface. In such silica support, the iron particles would be randomly distributed. A random distribution would not qualify as an array. The word "array" is generally defined as "An orderly arrangement," in *The American Heritage Dictionary, Second College Edition*, Houghton Mifflin Company, Boston, 1982. (See Exhibit A.) Since the catalyst metal of *Li* is embedded in an amorphous support having randomly-arranged pores formed from interconnecting spaces, the catalyst metal that is embedded in it, would also be randomly distributed in the silica. Such random distribution would hardly qualify as an array or "orderly arrangement." Furthermore, there is no suggestion or motivation, either in *Li* or in the knowledge generally available to one of ordinary skill in the art, to modify *Li* to provide an array of a plurality of metal catalysts on a substrate.

Moreover, as stated above, *Li* does not teach or suggest a method for growing single-wall carbon nanotubes, let alone, a macroscopic molecular array of single-wall carbon nanotubes. In fact, *Li* actually teaches away from the formation of an array with the deposition of metal catalyst on a substrate. When *Li* tried to grow nanotubes to form an array on a quartz plate coated using an iron nitrate solution that had been dried and reduced, *Li* did not form an array of any nanotubes, but a rather thick layer of multiwall nanotubes (30 nm in diameter) that grew randomly to form the thick layer. See *Li*, Col. 3, page 1702.

Taken as a whole, *Li* does not teach all the claimed elements of Claim 163, and, furthermore, there is no suggestion or motivation in *Li* or in the knowledge generally available to one of ordinary skill in the art to form a macroscopic molecular array of single-wall carbon nanotubes.

Claims 164-166 and 168-170 depend either directly or indirectly from Claim 163, and thus, Claims 164-166 and 168-170 are also not obvious for the same reasons Claim 163 is not obvious over *Li*. Furthermore, in addition to the lack of elements in *Li* and the lack of motivation and suggestion in *Li*, the dependent claims also have further distinguishing features. With regard to Claims 165-166, as stated above, *Li* does not teach or suggest an array of microwells. Regarding Claim 169, *Li* does not teach or suggest “catalysts in the form of pre-formed nanoparticles.” Regarding Claim 170, *Li* does not teach or suggest microwells, let alone “at least about one million microwells.”

Further, regarding Claim 170, the Examiner cites *In re Rose* 220 F.2d 459, 105 U.S.P.Q. 237 (C.C.P.A. 1955) for the proposition that “the number of catalyst islands used does not impart patentability.” As binding case law and the M.P.E.P. reflect, this is a misstatement of the law, and the Examiner’s reliance on *In re Rose* to make these obviousness rejections is misplaced.

The Federal Circuit and its predecessor court have long recognized that a claim, while not anticipated, can be held to be obvious when the *only* difference between the prior art and the claims was a recitation of relative dimension of the claimed invention *and* the invention having the claimed relative dimensions would not perform differently than the disclosure in the prior art reference. M.P.E.P. § 2144.04(IV)(A) (citing *In re Rose*, 220 F.2d 459, 105 U.S.P.Q. 237); *See also Gardner v. TEC Systems, Inc.*, 725 F.2d 1338, 1345, 220 U.S.P.Q. 777, 783 (Fed. Cir. 1984).

As noted above, there are differences between the prior art and the Claim 170 that go well beyond dimensional differences. Thus, the claimed invention is not simply increasing the number of microwells. Rather, it is the creation of a new and non-obvious method. The non-obviousness of the claimed invention under the present circumstance is in complete accord with Federal Circuit and its predecessor court’s long standing precedent, which reflects that when the size or amount of the invention leads to compositions that have unique and novel properties and

use (and also when something is produced that theretofore had not been able to be accomplished), that such an invention was non-obvious and patentable. *See In re Kirke*, 40 F.2d 765, 767, 5 U.S.P.Q. 539 (C.C.P.A. 1930);¹ *see also Gardner*, 725 F.2d at 1345, 220 U.S.P.Q. at 783.

Therefore, as a result of the foregoing, Applicant respectfully notes that a *prima facie* case of obviousness has not been established, and respectfully requests that the Examiner withdraw his rejection of Claims 163-166 and 168-170 under 35 U.S.C. § 103(a) as being anticipated by *Li*.

IV. CLAIMS OBJECTED TO

Examiner has objected to Claims 35 and 167. The reasons for the objections were not given, however, it is expected that the objections are due to the claims being dependent upon a rejected claim. Thus, Claims 35 and 167 have been rewritten in independent form including all the intervening dependencies.

IV. OTHER CLAIM AMENDMENT

Claim 163 was amended to correct an inadvertent omission in the claim by adding the word “and” between the end of element (a) and the beginning of element (b). No new matter was added by way of this amendment.

¹ The holding in *In re Rose* is premised upon the Court of Custom and Patent Appeal's opinion in *In re Kirke*. *See In re Rose*, 220 F.2d at 463, 150 U.S.P.Q. at 240 citing *In re Yount*, 171 F.2d 317, 318, 80 U.S.P.Q. 1441, 143 (C.C.P.A. 1948), which in turn cited *In re Kirke*, 40 F.2d 765, 5 U.S.P.Q. 539, all of which when discussing the implications of a change of size or amounts for potential inventions.


V. CONCLUSION

As a result of the foregoing, it is asserted by Applicant that the Claims in the Application are now in a condition for allowance, and respectfully request allowance of such Claims.

Applicant respectfully requests that the Examiner call Applicant's attorney at the below listed number if the Examiner believes that such a discussion would be helpful in resolving any remaining problems.

Respectfully submitted,

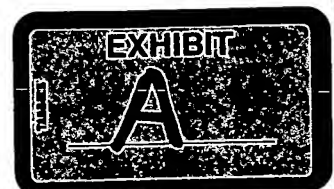
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arraign (ə-ˈraɪn) *tr.v.* **arraiged**, **arraig-ing**, **-raig-na**. 1. Low. To call before a court to answer to an indictment. 2. To call to account; charge: "Johnson arraigned the modern politics of this country as entirely devoid of all principle" (Boswell). [ME *arainen* < OFr. *araisnier* < VLat. **arationare*; Lat. *ad*, to + Lat. *ratio*, account. —see **REASON**.] —**arraigner** *n.*

arrange (ə-ˈraɪn) *v.* **rang-ed**, **-rang-ing**, **-rang-es**. —**tr.** 1. To put into a specific order or relation; dispose. 2. To plan or prepare for: *arrange a picnic*. 3. To agree about; settle: "It has been arranged for him by his family to marry a girl of his own class" (Edmund Wilson). 4. *Mus.* To select (music) for other instruments or voices or for another style of performance. —**intr.** 1. To come to an agreement. 2. To make preparations; plan: *arrange for a subcommittee*. [ME *arangen* < OFr. *aranger*; *ā*, to (< Lat. *ad*) + *rangier*, to put in a line < *reng*, list, of Germanic orig.] —**arranger** *n.*

arrangement (ə-ˈraɪn) *n.* 1. The act or process of arranging. 2. The condition, manner, or result of being arranged. 3. A collection or set of things that have been arranged. 4. Often *arrangements*. A provision or plan made in preparation for an undertaking. 5. An agreement or settlement; disposition. 6. *Mus.* a. An adaptation of a composition for other instruments or voices or to another style or level of difficulty. b. A composition so arranged.

arrant (ə-ˈrɒnt) *adj.* Being completely such; thoroughgoing: *an arrant knave*. [Var. of **ERRANT**.] —**arrantly** *adv.*

array (ə-ˈraɪ) *tr.v.* **rrayed**, **-rray-ing**, **-rrays**. 1. To arrange or draw up, as troops in battle order. 2. To deck in finery; adorn. —**n.** 1. An orderly arrangement, esp. of troops. 2. An impressive display of numerous persons or objects: "a kingly array of numerous clubs and spears" (Melville). 3. Splendid attire; finery. 4. *Math.* a. A rectangular arrangement of quantities in rows and columns, as in a matrix. b. Numerical data linearly ordered by magnitude. 5. An arrangement of computer memory elements in one or several planes. [ME *araien* < OFr. *arrecer* < VLat. **arredare*, of Germanic orig.]

arrayal (ə-ˈraɪ-əl) *n.* 1. The act or process of arraying. 2. Something arrayed; array.

arrears (ə-ˈrɪə) *n.* 1. The state of being in arrears. 2. An amount owed in payment.

arrear (ə-ˈrɪə) *pl.n.* 1. An unpaid and overdue debt or an unfulfilled obligation. 2. The state of being behind in fulfilling contracted obligations or payments: *in arrears*. [< ME *arre*, behind < OFr. *arere* < L.Lat. *ad retro*, backward: Lat. *ad*, to + Lat. *retro*, behind.]

arrest (ə-ˈrɛst) *tr.v.* **rested**, **-rest-ing**, **-rests**. 1. To stop or check the motion, progress, growth, or spread of. 2. To seize and hold under authority of the law. 3. To capture and hold briefly (the attention, for example); engage. —**n.** 1. a. The act of arresting. b. The state of being arrested. 2. A device for arresting motion, esp. of a moving part. —*Idiom.* *under arrest*. Detained in legal custody. [ME *arresten* < OFr. *arrest* < VLat. **arrestare*; Lat. *ad*, to + Lat. *restare*, to stand still (re-, back + *stare*, to stand).] —**arrestor** *n.* —**arrestment** *n.*

arresting (ə-ˈrɛst-ɪŋ) *adj.* Attracting and holding the attention; sinking. —**arrestingly** *adv.*

arhythmia (ə-ˈrɪθ-mi-ə) *n.* Any irregularity in the force or rhythm of the heartbeat. [Gk. *arrhythmia*, lack of rhythm < *arrhythmos*, arrhythmic; *ar-*, without + *rhythmos*, rhythm.]

arhythmic (ə-ˈrɪθ-mɪk) *adj.* Also **arhythmical** (ə-ˈrɪθ-mɪ-kəl) *adj.* Lacking rhythm or regularity of rhythm. —**arhythmically** *adv.*

arrière-ban (ə-ˈrɪə-ˈbən, -bān) *n.* 1. In medieval France, a royal proclamation by which vassals were summoned to military service. 2. The vassals summoned by an arrière-ban. [Fr. < OFr. *arrière-ban*, alteration of *herban*, of Germanic orig.]

arrière-pensée (ə-ˈrɪə-ˈpən-sā) *n.* An ulterior motive. [Fr. *arrière*, in back + *pensée*, thought.]

arête (ˈɑr-ɪt) *n., pl.* **arêtes** or **-rɪt-səz**. *Archit.* The sharp edge or ridge formed by two surfaces meeting at an angle, as in a molding. [Alteration of OFr. *arête*, ridge. —see **ARETE**.]

arrival (ə-ˈrɪ-vəl) *n.* 1. The act of arriving. 2. A person or thing that arrives or has arrived. 3. The reaching of a goal or objective as a result of some process or effort.

arrive (ə-ˈrɪv) *tr.v.* **ar-rived**, **-riving**, **-rives**. 1. To reach a destination. 2. To come at length; take place: *The day of crisis has arrived*. 3. To achieve success or recognition. —*Phrasal verb.* *arrive at*. To reach through some process or effort: *arrive at a decision*. [ME *ariven* < OFr. *ariver* < VLat. **arripere*; Lat. *ad*, to + Lat. *ripa*, shore.] —**arriver** *v.*

ariviste (ə-ˈrɪ-vɪst) *n., pl.* **-arivists** (-vɪst). A social climber or opportunist; upstart. [Fr. < *arriver*, to arrive < OFr. *ariver*.]

arbo (ə-ˈrɒ) *n.* *Archaic.* 1. A unit of weight in Spanish-speaking countries equal to about 25 pounds. 2. A unit of weight in Portuguese-speaking countries equal to about 32 pounds. 3. A liquid measure used in Spanish-speaking countries, having varying value, but approximately equal to 1 quart when used to measure wine. [Sp. and Port. < Ar. *arab*, the quarter (of a quintal).]

arro-gance (ə-ˈrɒ-gəns) *n.* The state or quality of being arrogant.

arrogant (ə-ˈrɒ-gənt) *adj.* 1. Overly convinced of one's own importance; overbearingly proud; haughty. 2. Characterized by or arising from haughty self-importance. [ME *arrogant* < OFr. < Lat. *arrogans*, pr.prt. of *arrogare*, to arrogate.] —**arrogantly** *adv.*

arrogate (ə-ˈrɒ-gət) *tr.v.* **-gated**, **-gating**, **-gates**. 1. To claim, take, or assume for oneself without right. 2. To attribute to another unwarrantably. [Lat. *arrogare*, *arrogat*; *ad*, to + *rogare*, to ask.] —**arrogation** *n.* —**arrogative** *adj.* —**arrogator** *n.*

arrondissement (ə-ˈrɒn-dēs-mən) *n.* 1. The chief administrative subdivision of a department in France. 2. A municipal subdivision of some large French cities. [Fr. < *arrondir*, to round out; *ā*, to (< Lat. *ad*) + *roundir*, to make round.]

arrow (ˈɑr-ə) *n.* 1. A straight, thin shaft that is shut from a bow and usually made of light wood with a pointed head at one end and flight-stabilizing feathers at the other. 2. Something similar to an arrow in form, function, or speed. 3. A sign or symbol shaped like an arrow and used to indicate direction. [ME *arwe* < OE *urewe*.]

arrowhead (ˈɑr-ə-hed) *n.* 1. The pointed, removable striking tip of an arrow. 2. Something shaped like an arrowhead, such as a mark indicating a limit on a drawing. 3. Any aquatic or marsh plant of the genus *Sagittaria*, having arrowhead-shaped leaves and white flowers.

arrowroot (ˈɑr-ə-rud, -rūt) *n.* 1. A tropical American plant, *Maranta arundinacea*, having roots that yield an edible starch. 2. The starch from the arrowroot and from certain plants of the genera *Manihot*, *Cucurbita*, and *Tacca*. [So called because it was used to draw poison from arrow wounds.]

arrow-wood (ˈɑr-ə-wud) *n.* Any of several small shrubs of the genus *Viburnum*, such as the dogwood, having straight tough stems formerly used by the Indians to make arrows.

arrow worm *n.* Any of various small, slender marine worms of the phylum Chaetognathus, having prehensile bristles on each side of the mouth.

arroyo (ə-ˈrɒj-ə) *n., pl.* **-os**. 1. A deep gully cut by an intermittent stream; dry gulch. 2. A brook or creek. [Sp., ult. < Lat. *arrogia*, mineshaft.]

arse (ɑrs) *n.* Chiefly Brit. Variant of **arse**.

arsenal (ˈɑr-sə-nəl) *n.* 1. A governmental establishment for the storing, manufacturing, or repairing of arms, ammunition, and other war material. 2. A stock of weapons. 3. A store or supply: *She arrived with an arsenal of assistants*. [Ital. *arsenale* < Ar. *dar-us-sindah*; *dar*, house + *us*, the + *sindah*, manufacture < *sanda*, he made.]

arsenate (ˈɑr-sə-nit, -nāl) *n.* A salt or ester of arsenic acid.

arsenic (ˈɑr-sə-nɪk) *n.* 1. A highly poisonous metallic element having three allotropic forms, yellow, black, or gray, of which the brittle, crystalline gray is the most common. Arsenic and its compounds are used in insecticides, wood killers, solid-state doping agents, and various alloys. Atomic number 33; atomic weight 74.922; valence 3 or 5. Gray arsenic melts at 817°C (at 28 atm pressure), sublimes at 613°C, and has a specific gravity of 5.73. 2. Arsenic trioxide. —*adj.*

arsenic (ˈɑr-sən-ɪk). Of or containing arsenic, esp. with valence 3. [ME *arsenik* < OFr. < Lat. *arsenicum* < Gk. *arsenikon*, yellow pigment < Pers. *zarnik* < zar, gold.]

arsenic acid (ˈɑr-sən-ɪk) *n.* A poisonous white translucent crystalline compound, H₃AsO₄, used to manufacture arsenates.

arsenical (ˈɑr-sən-ɪ-kəl) *adj.* Of or containing arsenic. —*n.* A drug or preparation containing arsenic.

arsenic trioxide (ˈɑr-sə-nɪk) *n.* A poisonous white amorphous powder, As₂O₃, used in insecticides, rat poison, and weed killers.

arsenide (ˈɑr-sə-nɪd) *n.* A compound of arsenic with a more electropositive element.

arsenious (ˈɑr-sən-ɪ-əs) *adj.* Of or containing arsenic, esp. with valence 3.

arsenopyrite (ˈɑr-sə-nɒ-pɪ-rit) *n.* A silver-white to gray arsenic ore, essentially FeS₂FeAs₂.

arsine (ˈɑr-shən) *n.* Variant of **arsine**.

arsine (ˈɑr-shən, ˈɑr-sen) *n.* A colorless, flammable, very poisonous gas, AsH₃, used as a military poison gas, as a solid-state doping agent, and in organic synthesis. [ARSENIC] + *-ine*.]

arsis (ˈɑr-ɪs) *n., pl.* **-ses** (-sɪz). 1. Originally, the unaccented or shorter part of a foot of verse. 2. In modern usage, the accented or longer part of a foot of verse. 3. *Mus.* The upbeat or unaccented part of a measure. [LLat., raising of the voice < Gk., upward beat < *arsinein*, to lift.]

arson (ˈɑr-sən) *n.* The crime of maliciously setting fire to the buildings or property of another or of burning one's own property for some improper purpose, as to collect insurance. [AN < OFr. *arçon* < Med. Lat. *arsio* < Lat. *ardere*, to burn.] —**arsonist** *n.*

arsphenamine (ˈɑr-sfən-ə-mèn) *n.* A yellow hygroscopic powder, C₁₂H₁₂N₂O₂As₂·2HCl·2H₂O, formerly used to treat syphilis. [ARSENIC] + *PHENYL* + *AMINE*.]

art (ɑrt) *n.* 1. Human effort to imitate, supplement, alter, or



arrowhead
Above: Tip of an arrow
Below: *Sagittaria latifolia*

arr / r / r / s / s / u / e / sh / ship, dish / t / t / i / g / t / thin, path / r / h / this, bath / e / ū / cut / ū / urge / v / valve / w / with / y / yes / z / zebra, size / r / m / about, item, edible, gallop, circus / æ / Fr. *leu*, Ger. *schön* / ū / Fr. *tu*, Ger. *über* / k / M. Ger. *ich*, Scot. *loch* / n / Fr. *bon*.